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The Relationship between Age and Subjective Well-Being: Estimating Within and Between Effects Simultaneously *

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Abstract

Based on data from the German Socio-Economic Panel (SOEP), we used a correlated random effects econometric framework to simultaneously estimate the within and between effects of age on subjective well-being. The proposed approach overcomes the ambiguity in the relationship between age and subjective well-being reported in a series of studies based on cross-sectional and/or longitudinal panel data. Our results suggest that a cubic-type functional relationship between well-being and age fits the data best, leading to highly significant coefficient estimates associated with the age variables, and consistent within and between effects of age on subjective well-being. A linear or quadratic functional relationship between well-being and age is not empirically supported, as the between and within estimates of age on well-being differ significantly from each other. The main findings are robust to the inclusion of a broad range of individual-level sociological, demographic, and economic controls, and to the inclusion of various interviewer controls such as survey experience, survey type, and interviewer fixed effects.

Keywords: Subjective Well-Being, Life Cycle Happiness, Cohort Effects, Mundlak Approach, Correlated Random Effects, Fixed Effects, Between- and Within-Person Effects

JEL Classification Numbers: I31, C21, C23, J10

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1 Introduction

Over the last few decades, the relationship between age and individual well-being[1] has been the subject of intense discussion in various research fields, including economics, gerontology, psychology, and sociology. Researchers from the different fields have provided a range of theoretical explanations for this relationship and tested them empirically. The functional relationships found between well-being and age in empirical studies are manifold. The findings range from U-shaped and inverted U-shaped relationships to linear or cubic relationships or no relationship at all. Moreover, theoretical explanations can be found for virtually any empirical relationship. The manifold number of theoretical explanations arise from the multidimensionality of channels by which age might affect subjective well-being (SWB). Those theoretical models range from consumption-smoothing (Fisher, 1930; Modigliani and Brumberg, 1954) and hyperbolic discounting (Frederick et al., 2002) models in economics to models of set point theory (Diener and Lucas, 1999; Lucas, 2007) and the hedonic treadmill (Kahneman, 1999) in psychology, to the satisfaction paradox (Mroczek and Kolarz, 1998) and socio-emotional selectivity theory (Munsey, 2007; Charles and Carstensen, 2009) in gerontology.[2]

A striking characteristic of the empirical literature is the persistence of arbitrary results concerning the functional form found. Most studies using cross-sectional data and analyzing the between-person variation of age find a U-shaped relation with a low around midlife (Blanchflower and Oswald, 2004, 2008; Graham and Ruiz Pozuelo, 2017; Hayo and Seifert, 2003; Lang et al., 2011). Studies by Mroczek and Spiro (2005) and Easterlin (2006) report an inverted U-shape based on very special datasets such as the US Department of Veterans Affairs (VA) Normative Aging Study (NAS) and the synthetic panel of the US General Social Survey (GSS). The studies by Frijters and Beatton (2012) and Kassenboehmer and Haisken-DeNew (2012) show that the U-shaped effect is persistent in a cross-sectional framework, while it disappears when the empirical analysis includes panel fixed effects to control for unobserved individual-level heterogeneity. Meanwhile, Kassenboehmer and Haisken-DeNew (2012) found that age has no effect on subjective well-being if the regression model accounts for the number of years the respondent has been part of the survey. Finally, in an empirical analysis of British and German representative household surveys, Wunder et al. (2013) report that subjective well-being follows a wave-like pattern over the life course: life satisfaction declines until midlife, then starts to increase, and eventually seems to decline again among the oldest old. The methodology used is quite different from previous approaches on the topic, as it implements a semi-parametric regression model with penalized splines (P-splines) to model the non-linear pattern of well-being across the life span. Overall, while theoretical explanations of the lifetime pattern of well-being vary widely across the scientific disciplines, the empirical evidence remains mixed even within the disciplines and especially in the literature on economics.[3]

In our review of the relevant literature, we identified three key methodological issues that we used to differentiate the empirical studies on lifetime patterns of well-being into groups. The first and most important methodological issue is the use of cross-sectional and/or longitudinal panel data. While in the first case, variation between survey respondents

[1] The terms well-being, happiness, and life satisfaction are used interchangeably in this article.

[2] Both, consumption smoothing and hyperbolic discounting rely on the assumption that expected utility equals experienced utility (Kahneman et al., 1997), which according to the theoretical framework in Ramsey (1928), yields increasing/constant/decreasing utility profiles depending on the difference between the time preference rate and the interest rate.

[3] See López Ulloa et al. (2013) for a review of the main findings in the relevant theoretical and empirical literature on the relationship between well-being and age.

is used to identify the effect of age on well-being over the life span, in the second case, it is the time variation within survey respondents. In contrast to cross-sectional and/or repeated cross-sectional data, the use of longitudinal panel data enables the inclusion of panel fixed effects in the regression model. The latter methodological approach provides coefficient estimates that are robust to individual-level heterogeneity due to the omission of key time-constant unobserved factors (for example, specific personality and/or genetic traits that might be correlated with both reported life satisfaction and longevity).

The second crucial difference between the empirical studies pertains to the specification of the age variable. Studies either employ indicator variables for each individual age category or pool individual observations into different age groups (defined for 10-, 5-, or 3-year intervals). Despite the functional flexibility of such an approach, it introduces the well-known identification problem regarding the simultaneous inclusion of birth cohort, time, and age effects into the regression model (Blanchflower and Oswald, 2008; Baetschmann, 2014). The majority of studies use higher-order polynomials of the age variable to examine the lifecycle pattern of well-being. For example, the U-shaped and/or inverted U-shaped relationship between well-being and age is typically tested using a quadratic specification of the age variable. Despite the functional simplicity of this approach, the use of higher-order polynomials predetermines the results to some extent. Specifically, the use of a quadratic function in age explicitly rules out more complicated relationships (e.g., a cubic association) between well-being and age.

The third important methodological difference between the studies is the selection of sociological, demographic, and economic individual-level controls that might confound the empirical relationship between well-being and age. Most researchers agree that factors such as household income, education, employment, health, marital status, gender, immigration status, number of children, birth cohort effects, panel attrition controls, survey-type fixed effects, and individual fixed effects (depending on the type of data employed, i.e., cross-sectional and/or longitudinal panel data) should be included as standard control variables in the regression model. However, there is little consensus among researchers as to whether the empirical analysis should explicitly account for time effects, the respondent's survey experience, and the possible confounding influence of the interviewer (e.g., interviewer gender and/or experience).

Overall, the plethora of associations between well-being and age (e.g., U-shape, flat, or wave-like pattern) could be a true empirical finding or could simply reflect a statistical artefact caused by study-level methodological differences in the type of data sets used, the econometric methods applied, the functional forms tested, and the set of control variables included. Given this heterogeneity, it should be clear that the literature is far from being able to draw final conclusions about the evolution of well-being over the life span.

Based on individual-level panel data from the German Socio-Economic Panel (SOEP) during the period 1992 to 2016, we propose a unified empirical framework to examine the impact of the aforementioned methodological issues on the relationship between well-being and age. To address the first methodological issue, we used a hybrid version of the correlated random effects (CRE) framework, first proposed by Mundlak (1978), to examine the within and between effect of age on individual well-being simultaneously. This estimation framework has proven particularly useful to relax the zero correlation assumption between variables that vary across time and the individual-level unobserved heterogeneity in a standard random effects (RE) estimation approach. Extending the regression model through the inclusion of individual-level group means of the time-variant explanatory variables and estimating this augmented model under the RE assumption effectively controls for individual-level heterogeneity. In contrast to the standard fixed effects regression model, the CRE

framework is capable of disentangling the within and between effects of time-variant controls. It is worth mentioning that this estimation framework even allows the inclusion of individual-level controls that do not vary over time (e.g., gender) and that would otherwise be lost when using the fixed effects estimator. We addressed the second methodological issue regarding the proper specification of the age variable by using higher-order polynomials for age. This allowed us to test competing theoretical explanations about the lifecycle pattern of well-being (i.e., linear, flat, U-shaped, inverted U-shaped, or wave-like patterns). We examined the last methodological issue by including a large battery of individual-level controls that have been identified as main determinants of differences in individual life satisfaction both across time and across individuals. Beyond the aforementioned standard sociological, demographic, and economic factors, we also examined the robustness in the association between well-being and age to survey-specific conditions such as the respondent's experience answering survey questions, the type of survey conducted (e.g., by phone or personal interview), whether the interview was conducted by a male, and whether the interviewer had extensive experience surveying respondents.

The results suggest that a cubic functional specification in the age variable leads to consistent within and between effects of age on well-being over the entire life span. This finding is consistent with a wave-like pattern in subjective well-being over the life span. Furthermore, this specification is highly robust to the inclusion of a broad range of individual-level controls. This is in stark contrast to the regression results either using a linear and/or quadratic specification of the age variable, in which the corresponding within and between effects of age on well-being are contradictory and extremely sensitive to the inclusion of additional individual-level controls. It is worth mentioning that for the quadratic model specification, the U-shaped pattern in well-being is only present for the between-person dimension, whereas the within-person results would predict that the association is *inverted* U-shaped. Since this finding is based on the same number of observations and/or individuals observed at different points in time, we conclude that the U-shaped pattern in well-being reported in previous studies could be a statistical artefact caused by the cross-sectional dimension of the underlying survey data.

The remainder of this paper is organized as follows. Section 2 provides a review of the relevant literature on the empirical association between well-being and age, followed by a discussion of the key methodological differences across studies and their implications for the revealed association between well-being and age. Section 3 discusses the validity of the proposed estimation strategy. Section 4 describes the data and variables employed in the empirical analysis. Section 5 describes the main empirical results. Finally, Section 6 concludes by summarizing the main findings.

2 Relevant Literature

In this section, we provide a systematic literature review on the empirical relationship between individual life satisfaction and age. We identify substantial methodological differences across empirical studies (e.g., type of data, econometric estimators, age coverage of survey respondents , and a set of included individual-level controls, among other factors) that prevent any final conclusions about the true relationship between well-being and age. We conclude that the plethora of empirical findings on the lifecycle pattern of well-being (e.g., U-shaped, flat, or wave-like pattern) could be a true empirical finding or could simply reflect a statistical artefact due to study-level methodological differences.

2.1 The Functional Relationship Between Subjective Well-Being and Age

Although a large number of studies have examined the relationship between subjective well-being and age, the literature is far from being able to draw definitive conclusions on the topic. In order to gain a broad understanding of the main findings, Table 6 provides a systematic review of relevant studies on the well-being-age nexus. The table reveals that the majority of the studies report a U-shaped relationship between subjective well-being and age, with a low point occurring between the mid-30s and mid-50s. Life satisfaction seems to decline from young adulthood until midlife, when it reaches a turning point and then increases again. This result is consistent across various social survey databases from many different countries.[4]

Using data on 500,000 randomly sampled individuals, Blanchflower and Oswald (2008) found evidence of the U-shaped curve in well-being in separate regressions of 72 developed and developing nations in America, Europe, Latin America, and Asia. Similarly, Graham and Ruiz Pozuelo (2017) found that the U-shaped relationship between well-being and age holds for 44 out of 46 individual countries. The authors used nationally representative household surveys from the Gallup World Poll (GWP) conducted during the years 2005 to 2011.

Some scholars still have serious reservations, however, and argue that the U-shaped curve in well-being over the life span could be a pure statistical artefact caused by study-level methodological differences. A striking observation is that the U-shaped pattern is found mainly in studies using cross-sectional or repeated cross-sectional observations. To account for unobserved factors confounding the statistical relationship between well-being and age, most studies include a standard set of individual-level controls such as income, marital status, gender, and employment status in the regression equation. These studies are mainly interested in examining the "pure" age effect on subjective well-being, i.e., the effect after accounting for objective life circumstances that are associated with age, such as the number of children or declining health.

A small number of studies examine the "unadjusted" pattern of well-being over the life span (i.e., without controlling for any socioeconomic factors). For example, Easterlin (2006) from a synthetic panel analysis of the US General Social Survey (GSS) found an inverted U-shaped relationship between well-being and age. Their ordered logit regression analysis of individual well-being measures only accounts for a limited number of demographic controls such as cohort effects, gender, ethnic variables, as well as education status – factors that barely change over time.

Remarkably, the U-shaped curve in well-being becomes relatively flat in regression models that explicitly account for panel fixed effects in longitudinal studies. For example, Frijters and Beatton (2012) looked for a U-shaped in well-being using three national representative longitudinal household surveys, i.e., the German Socio-Economic Panel (SOEP), the British Household Panel Survey (BHPS), and Household, Income, and Labour Dynamics in Australia (HILDA). The authors report that all three national representative household surveys refute the U-shaped curve in well-being typically found in pooled OLS regressions once individual fixed effects are accounted for in the regression analysis. In a parallel study, Kassenboehmer and Haisken-DeNew (2012) also found no U-shaped curve in well-being in the SOEP data, additionally controlling for the possible confounding effect of interviewer characteristics.

[4] Another approach to analyze the relation between age and subjective well-being is to use information on mental distress indicators or the use of anti-depressants. Lang et al. (2011) found that mental distress follows an inverted U-shaped pattern throughout the life cycle and that it is more prominent in low-income than in high-income households in a pooled cross-section of countries. Blanchflower and Oswald (2016) showed that the use of anti-depressants reaches a maximum in midlife and declines afterwards.

There are two notable exceptions to the U-shaped pattern in well-being based on longitudinal data but using different methodological approaches. One of these, Van Landeghem (2012), was an analysis of the SOEP, and the other, Cheng et al. (2017), used longitudinal panels from four household surveys, the SOEP, BHPS, HILDA, and MABEL, and found consistent evidence of a U-shaped relationship between well-being and age. The methodology used in both studies is quite different from previous longitudinal analyses, as it rests on the assumption that the first derivative of a quadratic function (i.e., the U-shaped pattern in well-being over the life span) is linear with a positive slope. However, it is worth mentioning that neither study includes panel fixed effects estimates; instead, both used a simple graphical method to examine the functional relationship between the mean yearly *changes* in overall subjective well-being and age. A positive and statistically significant linear function appears to provide evidence that the unadjusted (raw) pattern in well-being is U-shaped over the life span. Following the narrative in Easterlin (2006), neither the study of Van Landeghem (2012) nor Cheng et al. (2017) include other control variables in the regression analysis. Thus, it remains unclear whether the main findings are subject to unobserved individual-level heterogeneity.

Several other studies have looked at a more complicated functional relationship between well-being and age. Wunder et al. (2013) applied a semi-parametric regression model with penalized splines (P-splines) to the British (BHPS) and German (SOEP) longitudinal data. The authors found that well-being over the life span has three stages. The first two stages are described accurately by the U-shaped pattern in well-being found in previous studies and seem to fit people's experience until their late 60s. Afterwards, in the third stage of life, a decline in well-being takes place among the oldest old in both households surveys, consistent with the hypothesis of declining life satisfaction due to a deterioration of health among older people. Such a wave-like pattern in well-being has been replicated in several other independent studies (Gwozdz and Sousa-Poza, 2010; Baetschmann, 2014; Wooden and Li, 2014), suggesting that the U-shaped functional relationship might be too restrictive to describe the entire pattern of well-being over the life span.

Overall, the above review suggests that the flat, (inverted) U-shaped, and wave-shaped lifecycle patterns in well-being reported in the literature could reflect true empirical findings or simply be the consequence of study-level methodological differences. In principle, each of the functional relationships between well-being and age can be justified on some theoretical grounds.

For example, the economic life-cycle theory predicts that life satisfaction would be flat over the entire life span because of inter-temporal optimization of agents at each point in time (Blanchflower and Oswald, 2008; Van Landeghem, 2012). However, no standard economic theory exists that might explain the non-linear relationship between well-being and age over the life span, and any economic modelling that generates a non-linear (e.g., U-shaped) association between the two outcomes would be rather ad-hoc.

There are two overlapping explanations that might be consistent with the U-shaped pattern in well-being over the life span. One explanation is that the decline in life satisfaction up to midlife and its increase thereafter (the phenomenon also known as "midlife crisis") might be caused by lower and higher adaption levels, respectively , to missed goals and opportunities throughout life (Frey and Stutzer, 2002; Frijters and Beatton, 2012).[5] The second possibility is that the increase in life satisfaction after midlife could be explained by the fact that older people value the remaining years more

[5]This observation is consistent with neurological and psychological studies that argue that an individual's emotional reaction to missed chances and unmet aspirations decreases with age (Brassen et al., 2012).

because their friends are passing away (Blanchflower and Oswald, 2008).

Weiss et al. (2012) provided an alternative explanation of the U-shaped pattern in well-being. The authors showed that a similar U-shape exists among 508 great apes whose well-being was assessed by raters who had known the individual apes for at least two years. Their results imply that the U-shaped pattern in well-being is not uniquely human and that its origins are partly rooted in human biology beyond standard socioeconomic factors. These findings might help scientists across various disciplines to develop a theoretical framework that would explain the (possibly nonlinear) pattern in well-being over the entire life span.

The steep decline in well-being among the oldest old might be caused by a deterioration of health. Another explanation would be the *Effect of Impending Death*. Life satisfaction sharply declines in the years prior to death (Small and Beckmann, 1997). This effect is reported in studies that explicitly control for diseases that usually occur in around the same period, suggesting that the decline in life satisfaction among the oldest old is not entirely explained by a decrease in health status (Small et al., 2003). In combination with the U-shaped relationship between well-being and age, the latter argument would provide an explanation for why life satisfaction follows a wave-like pattern over the entire life span (Wunder et al., 2013).

In summary, given the heterogeneity of the studies in terms of (i) data design (e.g., cross-sectional, longitudinal panel, or repeated cross-sectional data), (ii) choice of econometric estimators (e.g., panel fixed effects, random effects, pooled OLS, ordered logit, or semi-parametric regression models), (iii) type of national household survey (e.g., country of origin, socio-demographic composition of survey respondents), (iv) definition of the age variable (e.g., continuous age function and/or step function for different age groups), (v) the choice of individual level controls (e.g., income, education, health, and marital status), (vi) the type of functional relationship tested (e.g., flat, U-shaped, or wave-shaped pattern), and (vii) the definition of the dependent variable (e.g., life satisfaction and/or general health questionnaire measure), a definitive conclusion about the pattern of well-being over the entire life span is difficult to draw. We contribute to the relevant literature by assessing the relative importance of the aforementioned methodological concerns that might confound the true relationship between well-being and age.

2.2 The Importance of Study-Level Methodological Differences

Beside the supposed functional relationship between well-being and age tested in the econometric estimations, the studies also exhibit broad heterogeneity regarding the choice of standard individual-level control variables. There is broad consensus in the empirical literature that sociological, demographic, and economic controls (e.g., income, household composition, employment, marital and health status) have to be included in the formal regression models to explain variation in well-being over time (Dolan et al., 2008). However, other studies refrain from controlling for social and economic factors in the regression models, since their focus is on the unadjusted (or raw) pattern of well-being over the life span (Easterlin, 2006; Easterlin and Sawangfa, 2007).

Studies can be further differentiated with respect to the inclusion of panel fixed effects that effectively account for unobserved individual-level heterogeneity across survey respondents. While the inclusion of panel fixed effects has become standard in studies using longitudinal data (Frijters and Beatton, 2012; Kassenboehmer and Haisken-DeNew, 2012), such an approach is technically not feasible when using cross-sectional or repeated cross-sectional data with a changing composition of survey respondents at each point in time (Stone et al., 2010; Graham and Ruiz Pozuelo, 2017). As the differences

between the two methodological approaches are well known, we refrain from repeating the technical arguments at this stage. Taken together, however, the findings from cross-sectional and longitudinal panel data studies offer an important insight: The inclusion of panel fixed effects in the regression model clearly affects the empirical association between well-being and age. As discussed above, Frijters and Beatton (2012) have shown that the U-shaped pattern in well-being becomes rather flat if the regression model controls for the possible confounding effects of unobserved individual-level heterogeneity.

Another important difference among the various studies is the consideration of birth cohort and/or time effects. The argumentation is that even though well-being remains constant over time, survey respondents born in different years might report on average different levels of well-being. This observation might result from different socialization strategies during the time period in which survey respondents were raised (Van Landeghem, 2012). Thus, the U-shaped pattern in well-being could simply be a statistical artefact reflecting the different levels of reported life satisfaction of heterogeneous individuals raised in different cohorts. Indeed, birth cohort factors are significantly correlated with subjective well-being (Gwozdz and Sousa-Poza, 2010; Baetschmann, 2014; Clark and Oswald, 2006; Graham and Ruiz Pozuelo, 2017; Fukuda, 2013; Clark, 2007). However, the U-shaped pattern in well-being over the life span remains statistically significant. This implies that the U-shaped relationship between well-being and age cannot be entirely explained by the inclusion of individuals born in different years.

Recent studies have begun to investigate the influence of response behavior, i.e., determinants of which might bias the respondent's answers on individual subjective well-being. The existing studies tackle two dimensions of this issue: first, the respondent's experience, and second, characteristics of the interviewer. The first dimension reflects the possibility that respondents might become more aware or honest the more often they answer questions regarding their well-being (see Wooden and Li (2014) for panel conditioning). This aspect is usually captured by controlling for the amount of time an individual has spent in the panel (Frijters and Beatton, 2012; Baetschmann, 2014; Kassenboehmer and Haisken-DeNew, 2012). On the other hand, Wooden and Li (2014) argued that a long participation in a survey might cause growing disinterest and disengagement on the side of the respondent, leading to panel attrition. To control for this, they propose including a dummy that marks individuals who drop out in the next wave of the survey.

The second dimension considers the possibility that the respondent might answer differently depending on the interviewer who carries out the survey. Kassenboehmer and Haisken-DeNew (2012) therefore included the interviewer's gender and experience as control variables in their estimations. The results show that this leads to insignificant coefficients on age, which calls the impact of age on subjective well-being into question. Closely connected to this issue is the type of technique in which the interview was carried out, e.g., face-to-face or by phone, questionnaire filled out by interviewer or with the help of the interviewer, with or without an interpreter. Therefore, Wooden and Li (2014) controlled for the interview type carried out and found that they have an impact on the reported subjective well-being.

Overall, it has to be stated that although there is consensus regarding the inclusion of very basic sociological, demographic, and economic control variables, studies still differ in the specification of the key age variable, the inclusion of interviewer characteristics, and the use of appropriate econometric techniques (e.g., panel fixed effects versus pooled OLS regressions). The latter is partly explained by the availability of cross-sectional and/or longitudinal panel data, but some studies have argued against the inclusion of panel fixed effects in empirical analyses based on longitudinal panel data (Baetschmann, 2014; Cheng et al., 2017).

Table 1: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Baetschmann (2014)	Blanchflower and Oswald (2004)	Blanchflower and Oswald (2008)	Blanchflower and Oswald (2016)	Cheng et al. (2017)
Data Type	pooled cross-sectional data	pooled cross-sectional data	pooled cross-sectional data	pooled cross-sectional data	longitudinal panel data
Sample Size	304,856	38,000 people from the US and 57,000 people from the UK	observations range between 18,000 and 945,000, depending on the survey used	about 28,000	BHPS (98,320), HILDA (80,389), SOEP (185,169), MABEL (9,297)
Time Coverage	1984-2009	1972-1998	depending on survey used	2005, 2006, 2010	BHPS (1991-2008), HILDA (2001-2010), SOEP (1984-2008), MABEL (2009-2011)
Number of Individuals	38,197	N/A	N/A	N/A	N/A
Methodology	pooled OLS regressions	ordered logit regressions	ordered logit regressions	pooled OLS, probit, ordered logit regression	pooled OLS regressions
Country	former West Germany	United States, Great Britain	various countries	27 European countries	Great Britain, Germany, Australia
Survey Type	German Socio-Economic Panel (SOEP)	US General Social Surveys (GSS) and UK Eurobarometer surveys	US General Social Surveys (GSS), World Values Surveys (WVS), Eurobarometer surveys, Latinobarometer surveys, Asianbarometer surveys, UK Labour Force Survey (LFS)	Eurobarometer surveys	British Household Panel Survey (BHPS), German Socio-Economic Panel (SOEP), Household, Income and Labour Dynamics in Australia (HILDA), Medicine in Australia Balancing Employment and Life (MABEL)
Age Coverage	20 to 80	N/A	varies depending on survey used	15 to 65	sample consists of people aged between 16 and 70
Age Variable	continuous age function, cohort indicators	continuous age function	continuous age function, age cohort indicators	step function defined for different age groups (10-year intervals)	continuous age function for the mean yearly changes in overall life satisfaction
Life Satisfaction Measure	life satisfaction measure (0=low to 10=high)	Happiness measure, US GSS (3-point scale), GB Eurobarometer surveys (4-point scale)	different psychological well-being measures (mental distress, work satisfaction, life satisfaction, depression) depending on survey used	consumption of anti-depressants, mental health issues	life satisfaction measure, BHPS (1 to 7), HILDA (0 to 10), SOEP (0 to 10), MABEL (0 to 10)
Controls	marital status, gender, number of children, employment status, education, income, satisfaction with health, panel duration	time, marital status, gender, race, employment status, education	education, marital and work force status, income, cohort effects	education, marital and work force status, gender	none
Functional Relationship	wave function	U-shaped relationship in happiness	U-shaped	inverted U-shaped pattern in the use of antidepressants	U-shaped
Turning Points	between age 55 and 70	between age 37 and 41, depending on survey type	around midlife depending on surveyed country	around midlife	BHPS (42.3), HILDA (40.1), SOEP (41.4), MABEL (46.9)
Main Findings	Life satisfaction is wave-shaped. Turning points are explained mainly by sample composition (e.g., unhappy people disappear between 55 and 70)	lifetime pattern of happiness, the U-shaped relationship between happiness and age is highlighted in a paragraph	life satisfaction (defined by different psychological well-being measures) is U-shaped over the life span for a large number of countries	the inverted U-shaped pattern in mental health problems confirms that subjective well-being is U-shaped in age	Life satisfaction is U-shaped over the life span in all four longitudinal datasets

Table 2: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Clark (2007)	Clark and Oswald (2006)	Easterlin (2006)	Easterlin and Sawangfa (2007)	Fischer (2009)
Data Type	longitudinal panel data	longitudinal panel data	pooled cross-sectional data	pooled cross-sectional data	cross-sectional data
Sample Size	136,055	about 100,000	29,000	29,000	44,000
Time Coverage	1991-2005	1991-2004	1973-1994	1973-1994	1997-1999, 1999-2001
Number of Individuals	N/A	N/A	N/A	N/A	44,000
Methodology	pooled OLS, random effects, and panel fixed effects regressions	pooled OLS, random effects, and panel fixed effects regressions	ordered logit regressions	ordered logit regressions	pooled OLS regressions
Country	Great Britain	Great Britain	United States	United States	30 OECD Countries
Survey Type	British Household Panel Survey (BHPS)	British Household Panel Survey (BHPS)	US General Social Surveys (GSS)	US General Social Surveys (GSS)	World Values Surveys (WVS)
Age Coverage	16 to 64	16 to 69	18 to 89	18 to 89	15 to 101
Age Variable	step function defined for different age groups (5-year intervals)	step function defined for different age groups (10-year intervals)	continuous age function	continuous age function	continuous age function
Life Satisfaction Measure	life satisfaction measure (0=low to 7=high scale), general health questionnaire score (0=low to 12=high scale)	life satisfaction measure (0=low to 7=high scale), general health questionnaire score (0=low to 12=high scale)	happiness measure (3-point scale), financial satisfaction (3-point scale), family satisfaction (7-point scale), health satisfaction (7-point scale), and job satisfaction (4-point scale)	happiness measure (3-point scale), financial satisfaction (3-point scale), family satisfaction (7-point scale), health satisfaction (7-point scale), and job satisfaction (4-point scale)	life satisfaction measure (1=low to 10=high)
Controls	education, marital and work force status, income, health and cohort effects	education, marital and work force status, income, health	race, gender, education and birth cohort effects	race, gender, education and birth cohort effects	education, marital and work force status, income, cohort effects, political ideology, religion, trust, and social capital
Functional Relationship	U-shaped	U-shaped	inverted U-shaped	inverted U-shaped	wave function
Turning Points	between age 45 and 49	between ages 40 and 49	at age 51	50	first (second) turning point between ages 41 and 46 (80 and 90)
Main Findings	life satisfaction is U-shaped with respect to age, which can be shown by plotting the coefficients of the step function, cohort effects do not fully explain these results	life satisfaction is U-shaped in age, which can be shown by plotting the coefficients of the step function	happiness of a birth cohort rises slightly from age 18 to midlife and declines slightly thereafter	the relationship between mean happiness and age varies by education, year and birth cohort, respectively. This holds for different satisfaction domains	empirical evidence suggests a wave-shaped relationship between life satisfaction and age

Table 3: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Frijters and Beatton (2012)	Galambos et al. (2015)	Gerstorf et al. (2008)	Graham and Ruiz Pozuelo (2017)	Gwozdz and Sousa-Poza (2010)
Data Type	longitudinal panel data	longitudinal panel data	longitudinal/panel	pooled cross-sectional data	longitudinal panel data
Sample Size	SOEP (176,770), BHPS (153,886), HILDA (75,529)	N/A	10,162	about 230,000	241,000
Time Coverage	SOEP (1984-2002, former West Germany sample), BHPS (1991-2009), HILDA (2001-2008)	7 waves from 1986 to 2010	1984-2005	2005-2014	1994-2006
Number of Individuals	SOEP (about 20,000), BHPS (about 2,500), HILDA (about 13,000)	968 for high school and 574 for university sample, respectively	1,637	N/A	39,000
Methodology	panel fixed effects regressions	hierarchical linear regression models	panel fixed effects and random effects regressions	OLS regression models	panel fixed effects regressions
Country	Germany, Great Britain, Australia	Canada (high school seniors; university seniors; two samples)	Germany	46 Countries from the GWP (Gallup World Poll)	Germany
Survey Type	German Socio-Economic Panel (SOEP), British Household Panel Survey (BHPS), Household Income Labour Dynamics Australia (HILDA)	Special surveys on Canadian high school seniors and university seniors with changing survey method (mail/telephone)	German Socio-Economic Panel (SOEP)	GWP (Gallup World Poll)	German Socio-Economic Panel (SOEP)
Age Coverage	SOEP (18 to 92), BHPS (18 to 90), HILDA (18 to 92)	18 to 43 and 23 to 37	71 to 101	N/A	16 to 94
Age Variable	continuous age and step function (5-year intervals)	growth curve analysis of age	continuous age and distance to death function	continuous age function	step function with different age groups (5-year intervals)
Life Satisfaction Measure	SOEP (scaled 0-10), BHPS (scaled 1-7), HILDA (scaled 0-10)	happiness (3-point scale)	life satisfaction (11-points scale)	life satisfaction (11-point scale) and stress measure (2-point scale, yes/no variable)	life satisfaction (11-points scale)
Controls	education, marital and work force status, income, health and cohort effects, years in panel	gender, parents' education, grades, self-esteem, marital status, unemployment, self-rated physical health	gender, education, and various interactions with age	marital status, gender, education, employment	marital status, labour force status, number of children, health, education
Functional Relationship	U-shape, flat	inverted U-shaped	linear	U-shaped	wave-shape
Turning Points	first turning point around age 55, second turning point around age 67	early 30s	N/A	varies across countries	first (second) turning point between ages 45 and 49 (70 and 74)
Main Findings	relative to 20-year olds, there is not much effect until around age 55, then a slight increase up to age 67, followed by a sharp decline around age 75	The inverted U-shaped relationship between happiness and age points to the advantage of the use of longitudinal panel data and panel regression models	life satisfaction declines over the life span, with a pronounced decline four years prior to death	Turning point varies with average happiness of a country and with the position in the well-being distribution. The U-curve (happiness and age) and the hump-shape (stress and age) are robust	life satisfaction shows a wave-shaped pattern over the life span, which disappears when controlling for birth cohort effects

Table 4: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Hayo and Seifert (2003)	Kassenboehmer and Haisken-DeNew (2012)	Lang et al. (2011)	Lobos et al. (2016)	McAdams et al. (2012)
Data Type	pooled cross-sectional data	longitudinal panel data	pooled cross-sectional data	cross-sectional data	longitudinal panel data
Sample Size	165,11	116,876	about 100,000	385	N/A
Time Coverage	1991-1995	1994-2006	1997-2006	May 2013, January 2014	1996-2000;2002-2004
Number of Individuals	N/A	N/A	N/A	385	24,094
Methodology	ordered logit regressions	panel fixed effects regressions	logistic regressions	ordered logit regressions	multilevel modelling to predict the outcome variable
Country	11 Eastern European countries	Germany	England	Maule region in Chile	Great Britain
Survey Type	special survey conducted by the Paul Lazarsfeld Society	German Socio-Economic Panel (SOEP)	annual Health Survey for England (HSE)	special survey on elderly people	British Household Panel Survey (BHPS)
Age Coverage	18 to 77	N/A	aged >15 years	60 to 90	16 to 93
Age Variable	continuous age function	continuous age function	logistic regressions by age group	continuous age function	continuous age function
Life Satisfaction Measure	financial satisfaction	life satisfaction measure (0=low to 10=high)	12-item Generalized Health Questionnaire (GHQ) scores, mental illness diagnoses, and receipt of relevant medication	happiness (3-point scale) calculated from the sum of four items (7-points scale)	eight domains of life satisfaction measures (7-point scale)
Controls	ideology, economic situation five years ago and in five years, gender, income, education, employment, marital status, religion	marital and employment status, health, income, household composition, respondent's survey experience and interviewer fixed effects	ethnicity, income, smoking, social class, education, co-morbidities	employment, gender, partnership, several scales on subjective satisfaction with circumstances	none
Functional Relationship	U-shaped	U-shape, flat	inverted U-shaped relationship in mental illness measures is consistent with the U-shaped pattern in life satisfaction over the life span	inverted U-shaped	wave-shape pattern in life satisfaction, but argumentation mostly about the U-shape up to 75 years
Turning Points	around age 37	N/A	between ages 45 and 54	around age 77.5	first (second) turning point between ages 36 to 44 (72 to 76)
Main Findings	life satisfaction is U-shaped in age. The effect is robust to the inclusion of other socio-demographic and economic variables	the U-shaped pattern of well-being disappears once controlling for interviewer and panel duration fixed effects	The prevalence of increased mental issues in midlife is more prominent in low-income households	happiness is U-shaped over the life span. Public policies on older adults in rural areas should account for subjective well-being factors and not only for objective ones	satisfaction in some life domains increases after middle age, while it decreases in others, life satisfaction may balance out overall

Table 5: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Morgan et al. (2015)	Mroczek and Spiro (2005)	Mroczek and Kolarz (1998)	Piper (2015)	Schwandt (2016)
Data Type	cross-sectional data	longitudinal panel data	cross-sectional data	longitudinal panel data	longitudinal panel data
Sample Size	46,301	8,997	2,727	30,942	132,609
Time Coverage	2012	1978-1999	1995, 1996	BHPS (1996-2000, 2002-2007), wave 11 (2001) excluded	1991-2002
Number of Individuals	N/A	1,927	2,727	9,821	23,161
Methodology	structural regression models	panel fixed effects and random effects regression models	OLS regression models	panel fixed effects regression for static and panel GMM regressions for dynamic panel data models	non-parametric approach in the analysis of life satisfaction forecast errors
Country	29 European countries	United States	United States	Great Britain	Germany
Survey Type	European Social Surveys (ESS)	Veteran Affairs (VA) Normative Aging Study (NAS)	Midlife in the United States Survey (MIDUS)	British Household Panel Survey (BHPS)	German Socio-Economic Panel (SOEP)
Age Coverage	20 to 79	40 to 85	25 to 74	16 to 30	17 to 85
Age Variable	continuous age function	continuous age function	continuous age function	step function with different age groups (4-years intervals)	step function for each age
Life Satisfaction Measure	three domains of hedonic well-being and ten domains of eudaimonic well-being	life satisfaction measure	positive/negative affect	life satisfaction (7-point scale)	forecast errors in life satisfaction over a 5-year period
Controls	N/A	N/A	personality, socio-demographic, and contextual variables	income, job status, marital status, education, health	gender, East/West Germany dummy, educational status
Functional Relationship	life satisfaction is U-shaped/flat/increasing over the life span	inverted U-shaped	positive affect is U-shaped while negative affect declines linearly with age	U-shaped	wave-shape
Turning Points	around age 50s, but results only hold for high-income countries	around age 65	around age 35	N/A	mid 50s and 70s
Main Findings	life satisfaction is rather flat (negative) over the life span in high-income (low-income) countries. The U-shaped pattern in life satisfaction is conditional on national GDP per capita income levels	life satisfaction increases until age 65 and then declines. The rate of change depends on personal characteristics (e.g., extraversion)	personality, contextual and socio-demographic variables, as well as their interactions contribute significantly to the age-affect relationship	life satisfaction is U-shaped in age. Results from the dynamic panel analysis indicate that this finding is a lifecycle effect	young people overestimate, while elderly underestimate future life satisfaction. The U-shape of the age-well-being relationship in midlife is consistent with the hypothesis of unmet aspirations

Table 6: On the Relationship Between Well-Being and Age: A Review of the Relevant Empirical Literature

Study Design/Author, Date	Stone et al. (2010)	Van Landeghem (2008)	Van Landeghem (2012)	Wooden and Li (2014)	Wunder et al. (2013)
Data Type	cross-sectional data	longitudinal panel data	longitudinal panel data	longitudinal panel data	longitudinal panel data
Sample Size	340,847	206,911	N/A	130,211	BHPS (123,656), SOEP (253,044)
Time Coverage	2008	1985-2007	1985-2007	2001-2010	BHPS (1996-2006), SOEP (1986-2007)
Number of Individuals	340,847	32,470	44,960	21,280	BHPS (23,785), SOEP (33,451)
Methodology	weighted least squares regression models	pooled OLS and panel fixed effects regressions	pooled OLS regressions	panel fixed effects regressions	semi-parametric regression model with penalized splines (P-splines)
Country	United States	Germany	Germany	Australia	Germany, Great Britain
Survey Type	Gallup World Poll (GWP)	German Socio-Economic Panel (SOEP)	German Socio-Economic Panel (SOEP)	Household Income Labour Dynamics Australia (HILDA)	German Socio-Economic Panel (SOEP), British Household Panel Survey (BHPS)
Age Coverage	18 to 85	aged >17 years	17 to 85	aged >14 years	N/A
Age Variable	step function with different age groups (3-years intervals)	continuous age function, step function with different age groups (4-years intervals)	continuous age function	continuous age function	P-splines to estimate the smooth function for age
Life Satisfaction Measure	measures of global (long term) and hedonic (affective) well-being	life satisfaction (11-point scale)	life satisfaction (11-point scale)	life satisfaction (11-points scale)	life satisfaction, BHPS (7-points scale), SOEP (11-points scale)
Controls	gender, partnership, children, employment status	marital status, employment status, cohort effects, income, gender, education	marital status, employment status, cohort effects, income, gender, education	home ownership, equity, location, interview mode, labor force status, panel attrition to control for selectivity bias	N/A
Functional Relationship	U-shaped pattern in positive hedonic and global well-being, inverted U-shaped pattern in negative hedonic well-being	U-shape, wave-shape	life satisfaction is U-shaped in age using pooled OLS	third-order polynomial function for age	the semi-parametric approach allows for more flexibility in the well-being-age pattern
Turning Points	around the 50s	between ages 42 and 52	42-52	first (second) turning point around age 40 (70)	first (second) turning point around age 48 (78) for BHPS and 52 (65) for SOEP
Main Findings	global and positive hedonic well-being is generally U-shaped over the life span. The inclusion of additional controls that might co-vary with the age-well-being pattern did not change the main findings	U-shape in pooled OLS regressions. No or small positive effect in fixed effects models that control for birth cohort effects	life satisfaction is U-shaped in age using pooled OLS, although other patterns cannot be excluded. The challenge is to disentangle age, time, and cohort effects on life satisfaction	the cubic relationship between life satisfaction and age becomes very flat during much of midlife. Findings are still significant when controlling for panel attrition effects	life satisfaction is wave-shaped over the life span

Due to the large variety of methodological approaches, it is not possible to reach a definitive conclusion as to which set-up would be the best choice and how specific methodological issues might affect the results. We therefore used a common empirical framework with a single representative household survey (SOEP) where we could account for cross-sectional and longitudinal variation across survey respondents and a variety of control variables, and tested for different functional relationships between well-being and age.

3 Estimation Methodology

To disentangle the between and within effects of individual-level control variables on subjective well-being, we followed the methodology in Mundlak (1978) and estimated a hybrid version of the correlated random effects (CRE) framework. As shown below, this model framework goes beyond the commonly used fixed effects (FE) regression model by *simultaneously* estimating the between and within effects of time-variant individual-level controls. It is worth mentioning that this methodology even allows the inclusion of time-constant variables that could otherwise not be estimated when using the FE estimation framework.

We start the discussion on the proposed empirical framework using the following linear regression model

$$LS_{it} = \beta + \boldsymbol{\beta}_D \mathbf{D}_{it} + \boldsymbol{\beta}_E \mathbf{E}_{it} + \boldsymbol{\beta}_{ID} \mathbf{ID}_{it} + \boldsymbol{\beta}_G \mathbf{G}_{rt} + \boldsymbol{\beta}_Z \mathbf{Z}_i + \varepsilon_{it}, \tag{1}$$

where LS is the well-being (or life satisfaction) of individual i at time t, $\mathbf{D}_{it}$ is a vector of demographic controls (e.g., age, marital and health status), $\mathbf{E}_{it}$ is a vector of economic controls (e.g., personal income, education and employment status), $\mathbf{ID}_{it}$ is a vector of interviewer design controls (e.g., interviewer ID and survey-type fixed effects), $\mathbf{G}_{rt}$ is a set of various time fixed effects that vary across regions and years (e.g., state-year fixed effects), and $\mathbf{Z}_i$ is a vector of time-constant individual characteristics (e.g., gender and native status).

The strict exogeneity assumption between the explanatory variables and the error term ε_{it} determines the estimation methodology of this regression equation. We first discuss the FE regression model for estimating within effects on subjective well-being that are robust to unobserved individual-level heterogeneity. We then contrast this model specification with the CRE framework and show that the latter approach has the advantage of estimating simultaneously between and within effects of explanatory variables.

In the FE estimation framework, the composite error term takes the form $\varepsilon_{it} = \alpha_i + v_{it}$, which results in the following regression equation

$$LS_{it} = \beta + \boldsymbol{\beta}_D^{FE} \mathbf{D}_{it} + \boldsymbol{\beta}_E^{FE} \mathbf{E}_{it} + \boldsymbol{\beta}_{ID}^{FE} \mathbf{ID}_{it} + \boldsymbol{\beta}_G^{FE} \mathbf{G}_{rt} + \boldsymbol{\beta}_Z \mathbf{Z}_i + \alpha_i + v_{it}, \tag{2}$$

where α_i is the individual-specific (unobserved) heterogeneity that is allowed to be arbitrarily correlated with the set of explanatory variables, e.g., $\mathbb{E}\left[\alpha_i | \mathbf{D}_{it}, \mathbf{E}_{it}, \mathbf{ID}_{it}, \mathbf{G}_{rt}\right] \neq 0$. The FE approach effectively controls for time-invariant individual-specific factors that may be correlated with the time-variant explanatory variables. The coefficient vector on the time-variant explanatory variables was identified using the within-variation across individual observations. However, the robustness of the coefficient estimates in the presence of time-constant omitted factors comes at the cost that the effects of any individual-specific time-invariant variables (e.g., gender and ethnic background) are indistinguishable from the unobserved effect α_i, and thus cannot be estimated when using the FE estimation approach. In addition, coefficient estimates of rarely changing variables will be inefficient because of insufficient within-individual variation. For example,

the effect of education, marital status, and employment will be hard to assess in an FE framework since these variables change very slowly over time and therefore cannot be fully distinguished from the arbitrary individual-level effect α_i.

In the CRE framework, the relationship between the unobserved effect α_i and the time-variant explanatory variables is *explicitly* modeled to relax the restrictive zero correlation assumption $\mathbb{E}[\alpha_i|\mathbf{D}_{it}, \mathbf{E}_{it}, \mathbf{ID}_{it}, \mathbf{G}_{rt}] = 0$ within the random effects (RE) framework (Wooldridge, 2010a). Mundlak (1978) showed that the concrete specification of the unobserved effect makes the distinction between the FE and RE approach arbitrary and unnecessary. Following the notational convention in Wooldridge (2010a), we write the composite error in the CRE framework as

$$\varepsilon_{it} = \boldsymbol{\pi}_D \overline{\boldsymbol{D}}_i + \boldsymbol{\pi}_E \overline{\boldsymbol{E}}_i + \boldsymbol{\pi}_{ID} \overline{\boldsymbol{ID}}_i + \boldsymbol{\pi}_G \overline{\boldsymbol{G}}_i + a_i + v_{it}, \tag{3}$$

where a bar over a variable refers to time averages of the time-variant explanatory variables calculated on the set of time periods of individual i employed in the estimation. In contrast to the standard RE assumption, the unobserved heterogeneity effect α_i is allowed to be correlated with the time-variant explanatory variables according to the relationship $\alpha_i = \boldsymbol{\pi}_D \overline{\boldsymbol{D}}_i + \boldsymbol{\pi}_E \overline{\boldsymbol{E}}_i + \boldsymbol{\pi}_{ID} \overline{\boldsymbol{ID}}_i + \boldsymbol{\pi}_G \overline{\boldsymbol{G}}_i + a_i$, where a_i is now assumed to be uncorrelated with the time-variant explanatory variables in a standard RE estimation framework. Substituting expression (3) into Equation (1) results in the following CRE regression equation, as first proposed by Mundlak (1978)

$$\begin{aligned} LS_{it} &= \beta + \boldsymbol{\beta}_D^{FE} \mathbf{D}_{it} + \boldsymbol{\beta}_E^{FE} \mathbf{E}_{it} + \boldsymbol{\beta}_{ID}^{FE} \mathbf{ID}_{it} + \boldsymbol{\beta}_G^{FE} \mathbf{G}_{rt} \\ &+ \boldsymbol{\beta}_Z \mathbf{Z}_i + \boldsymbol{\pi}_D \overline{\boldsymbol{D}}_i + \boldsymbol{\pi}_E \overline{\boldsymbol{E}}_i + \boldsymbol{\pi}_{ID} \overline{\boldsymbol{ID}}_i + \boldsymbol{\pi}_G \overline{\boldsymbol{G}}_i + a_i + v_{it}. \end{aligned} \tag{4}$$

Extending the basic random effects regression model by including individual-level group means of time-variant explanatory variables effectively controls for arbitrary individual-level heterogeneity. Thus, the RE estimate of the time-variant explanatory variables (e.g., $\boldsymbol{\beta}_D^{FE}, \boldsymbol{\beta}_E^{FE}, \boldsymbol{\beta}_{ID}^{FE}, \boldsymbol{\beta}_G^{FE}$) are identical to the FE estimate in Equation (2).[6] More importantly, the coefficient estimates of the individual-level group means (e.g., $\boldsymbol{\pi}_D, \boldsymbol{\pi}_E, \boldsymbol{\pi}_{ID}, \boldsymbol{\pi}_G$) refer to the difference of the between and within effects, i.e., $\boldsymbol{\pi}_\delta = (\boldsymbol{\beta}_\delta^B - \boldsymbol{\beta}_\delta^{FE})$ for $\delta = (D, E, ID, G)$.

It is worth mentioning that the formulation in Equation (4) is analogous to a simple regression-based test of the Hausman statistic in comparing the RE and FE estimators (Wooldridge, 2010b). It can be shown that the RE estimate is a matrix-weighted average of the within and between estimator (Baltagi, 2008). Therefore, specifying the hypothesis that $\boldsymbol{\pi}_\delta$ equals zero would provide a formal statistical test of the differences in coefficient estimates from the FE and RE approach. Rejection of the null hypothesis that $\boldsymbol{\pi}_\delta$ equals zero would suggest that substantial individual-level heterogeneity is present in the data.

Given the fact that the coefficient estimate of the individual-level group means refers to the difference of the within and between estimate, Allison (2009) suggested the following hybrid version in the CRE framework in Equation (4)

$$\begin{aligned} LS_{it} &= \beta + \boldsymbol{\beta}_D^{FE}(\mathbf{D}_{it} - \overline{\boldsymbol{D}}_i) + \boldsymbol{\beta}_E^{FE}(\mathbf{E}_{it} - \overline{\boldsymbol{E}}_i) + \boldsymbol{\beta}_{ID}^{FE}(\mathbf{ID}_{it} - \overline{\boldsymbol{ID}}_i) + \boldsymbol{\beta}_G^{FE}(\mathbf{G}_{rt} - \overline{\boldsymbol{G}}_i) \\ &+ \boldsymbol{\beta}_Z \mathbf{Z}_i + \boldsymbol{\beta}_D^B \overline{\boldsymbol{D}}_i + \boldsymbol{\beta}_E^B \overline{\boldsymbol{E}}_i + \boldsymbol{\beta}_{ID}^B \overline{\boldsymbol{ID}}_i + \boldsymbol{\beta}_G^B \overline{\boldsymbol{G}}_i + a_i + v_{it}. \end{aligned} \tag{5}$$

Estimating this equation under the standard RE assumption, the coefficient estimates of the time-variant explanatory variables, again, are identical to the FE estimates. The only difference refers to the interpretation of the coefficient

[6] The interested reader is referred to Mundlak (1978) and Wooldridge (2010b) for a technical proof.

estimates of the individual-level group means. Under the CRE model, this coefficient estimate indicates the difference of the within and between estimate, whereas in the hybrid version, this estimate directly refers to the between estimate (Schunck, 2013). Although the FE estimate in the hybrid version remains unbiased irrespective of whether one includes individual-level group means in Equation (5), its inclusion ensures that the coefficient estimate on the time-invariant individual-level controls (e.g., $\mathbf{Z}_i$) is robust to between-individual-level heterogeneity in the time-variant explanatory variables (Schunck, 2013).

In contrast to the FE approach, the proposed CRE framework provides a number of statistical advantages that allow for more in-depth analysis of key research questions (Bartels, 2015). The hybrid version of the CRE estimation approach can be seen as a unified estimation framework that explicitly separates the within and between estimates in a standard RE framework. For example, the within coefficient estimate regarding age would predict how individual well-being is affected as the particular person becomes older *over* time. This would correspond to a purely individual-specific effect, and one should strictly avoid interpreting this effect for between-individual comparisons. The between-individual effect of age is consistently estimated when focusing on the coefficient estimate associated with the mean age variable. In this case, the coefficient of the mean age variable would provide evidence as to how individual well-being is affected when we compare two individuals of different ages.

Second, it is noteworthy that the CRE framework, in contrast to the FE approach, allows the inclusion of key explanatory variables that do not vary over time (e.g., gender and ethnic background). More importantly, this model framework provides an appropriate statistical tool to evaluate the between estimate of slowly changing variables (e.g., education, marital status, and employment) on individual well-being, where the within-estimate in the FE framework would usually indicate no statistical association due to insufficient within variation of observational units.

Finally, contrasting the within and between estimates in a single regression model provides a statistical framework to test the equality of the within and between estimate of key explanatory variables.

4 Data and Variables

Throughout the empirical analysis, we have used data from the German Socio-Economic Panel (SOEP). It is a representative panel that contains a wide range of survey data on the personal and household level from 1984 to 2016. The survey is conducted in annual waves of around 20,000 individual respondents and 11,000 households per year. The individuals are interviewed repeatedly, making the SOEP one of the longest-running panel studies worldwide. It is one of the most frequently used data sources in happiness research (Wagner et al., 2007). The SOEP was extended in 1990 to include former East Germany. We use data from 1992 onwards to avoid bias caused by the effect of reunification in 1990. Due to this restriction, to missing information on interviewer characteristics in several observations, and to the removal of individuals who took part only once in order to prevent a bias of the within effect in comparison to the between effect, we ended up with a sample of 49,756 individuals and 382,012 observations.

The main questionnaire consists of questions on household and personal characteristics as well as other individual and socio-economic characteristics. The question about individual life satisfaction that we use as our measure of SWB appears in the questionnaires as: "*How satisfied are you at present with your life, all things considered? Please respond using the following scale, where '0' indicates not at all satisfied and '10' indicates completely satisfied*".

We used the standard correlates found to influence subjective well-being in the literature (e.g., health, marital status, income, number of children, education, employment, and gender).[7] Furthermore, we controlled for interviewer fixed effects and the experience of individuals within the panel. We therefore followed the suggestion in Kassenboehmer and Haisken-DeNew (2012), pointing out that the U-shaped relationship between subjective well-being and age is sensitive to the inclusion of these variables.

To control for income differences across survey respondents, we used information on monthly net household income (in EUR) reported by the head of the household. Furthermore, we controlled for the employment status of an individual using a dummy indicating whether he or she was employed at the time of the interview. To account for individual health status, we used a measure of self-rated current health status on a five-point Likert scale ranging from *very good*=1 to *bad*=5. For gender, we used a *Male* indicator that takes a value of 1 for male and 0 for female respondents. We also implemented a dummy for ethnicity with respect to country of birth, which takes a value of 1 for individuals born in Germany or German immigrants prior to the year 1949 and 0 otherwise. We did not differentiate among ethnicities other than German since the respective categories would be very small. Referring to the differences in the education of the respondents, we used a set of indicator variables to distinguish among individuals with less than secondary education and those with completed secondary education . To control for marital status, we used five categories distinguishing whether an individual is single, married, separated, divorced, or widowed. The survey experience of individuals was measured by the number of times they participated in the survey. The same holds for interviewer experience.

5 Empirical Results

Tables 7 to 9 present the results on the SWB and age relationship using the proposed Mundlak (1978) estimation approach. In Table 7, the age variable enters in a simple linear form into the regression equation. In Tables 8 and 9, we used a quadratic and cubic functional relationship of the age variable, respectively, to examine a possible non-linear (e.g., U-shaped or wave-shape) pattern of well-being over the life span.

Following the relevant literature, we used a standard set of individual level controls throughout all model specifications: log of net income, employment status, health status, gender, country of origin of the respondent, educational status, marital status, number of children, birth decade FE, panel attrition, survey-type FE, panel individual level FE, and a full set of state-year FE. The inclusion of state-year FE in the regression model captures time-variant unobserved factors across the 16 German federal states, such as differences in labor market policies, infrastructure quality, and public assistance to certain industrial sectors that affect all persons within the same federal state equally. In all three tables, the results of this basic specification are given in column (1). Thereafter, we subsequently introduced survey experience, interviewer gender, interviewer experience, and interviewer FE into the regression model (columns 2 to 5).

The regression in Table 7 column (1) tests a simple linear association between SWB and individual's age. It is worth mentioning that the proposed Mundlak estimation approach clearly distinguishes between within-person and between-person effects. Thus, in panel A, the results of the within-person dimension are reported, while panel B refers to the between-person effects. Regarding the basic control variables log net income, employment and health, the estimated

[7] For reviews on the determinants of subjective well-being in the literature, see Diener et al. (1999) and Dolan et al. (2008).

regression coefficients are of the expected signs and statistically significant at conventional significance levels. Furthermore, within and between effects are in line with each other, i.e., sign and significance are the same along the two dimensions. These findings hold throughout all model specifications.

Concerning the effect of age on SWB, the within effect is insignificant, suggesting that age ceteris paribus does not have a separate impact on SWB (see Table 7, column (1), Panel A). In contrast, the between effect shows a positive and highly significant effect of age on SWB (Panel B). Thus, the within and between effects of age on SWB are not consistent with each other.

The specification presented in column (2) examines the sensitivity of the main results to the individual's survey experience. Specifically, we constructed a years-in-panel variable for each respondent that reflects the number of times a respondent appears in the survey. This variable was intended to control for the possibility that respondents spending many years in the survey may become more aware or honest about their level of happiness (Frijters and Beatton, 2012; Kassenboehmer and Haisken-DeNew, 2012). We used a logarithmic specification of the years-in-panel variable to account for the possibility that survey respondents may settle relatively quickly at a reported level of happiness after a few survey rounds. This is in line with Wooden and Li (2014), who found that in their quadratic modelling the turning point was located at the end of the observed time span. The identification of the years-in-panel effect from the individual's age (both monotonically increasing over time) was maintained due to panel exit and entry of survey respondents over time. The estimates in column (2) indicate that longer survey experience does indeed lead to lower reported SWB, both in the within and the between dimension. Reassuringly, the main results regarding the age and SWB relationship are not sensitive to the inclusion of the individual's survey experience.

In columns (3) and (4), we followed the suggestions in Kassenboehmer and Haisken-DeNew (2012) and controlled for the possible influence of interviewer gender and experience (measured as logarithm of the number of years of experience the interviewer has in surveying individuals in the German SOEP). The hypothesis was that male and experienced interviewers may be regarded as trustworthy and thus cause survey respondents to reveal their true level of happiness. The findings in column (4) indicate that both the interviewer's gender and the interviewer's experience have a significant negative impact on the reported SWB. This finding applies to the within as well as to the between effect. Again, the coefficients of the age variables are not sensitive to this model specification.

Finally, we included a full set of interviewer ID FE to control for arbitrary unobserved interviewer heterogeneity that might affect the respondent's survey behavior (column 5).[8] While the control variables remained largely unchanged, with exception of the between effect of interviewer experience, which now became insignificant, the coefficient of the within effect of age changed substantially. The coefficient increased from 0.0814 to 0.3487 and became highly statistically significant at conventional significance levels, suggesting that SWB increases linearly over the life span. This now mirrored the findings for the between dimension. Note that the within R^2 increased by 1.4 percentage points to 10.2% and the between R^2 by 5.5 percentage points to 45.9%. Figure 1 shows the absolute and marginal within and between effects of age on SWB based on the results in Table 7. As the figure illustrates, the coefficients of the within effect were more sensitive to the introduction of the interviewer FE than those of the between effect.

In Table 8, we tested for a possible quadratic relationship between SWB and age. Interestingly all control variables kept

[8]The interviewer gender variable dropped out because it was captured by the interviewer FE.

their sign and significance level, and even the sizes of the coefficients were similar compared to the coefficient estimates reported in Table 7. The same observation held for the different R^2s, which remained largely unchanged.

However, the findings concerning the relation between age and SWB changed substantially. All specifications indicate a quadratic relation between SWB and age. Yet while the results of the between dimension indicate the well-known U-shaped relation, the relation in the within dimension turns out to be inverse U-shaped. This finding holds throughout all model specifications. As Figure 2 illustrates, the findings concerning the within effect changed substantially with the inclusion of additional control variables. While the absolute within effect in column (1) is negative for all ages, in the remaining specifications, it becomes positive (columns 2 to 5). In addition, the findings in columns (2) to (4) indicate that there is a turning point around the age of 80, the specifications in columns (1), (2) and (5) show no turning point within the sample. For the latter specifications, other functional forms might be suitable as well, e.g., linear and/or a logarithmic specification. On the other hand, the between effect of age on SWB is rather uniform throughout the different model specifications. The absolute effect is negative until the age of 60 (columns 1 to 4) and 70 (column 5), respectively. The turning point is between the age of 30 and 35.

Since we analyzed the same individuals for both the within and between dimensions, the different results for the within and between effects of age on SWB are not justifiable either theoretically or econometrically. This contradiction is therefore an indication of a functional misspecification regarding the relationship between SWB and age.

Finally, Table 9 provides regression coefficients using a third-order polynomial specification in the age variable (i.e., a cubic specification) and its association with SWB. Again, the estimated sign, magnitude, and significance levels of the standard control variables remained largely unchanged throughout all model specifications, although the R^2s in column (5) are the highest of all model specifications and differ only in the third decimal place.

The cubic relation between SWB and age is affirmed in all model specifications and both for the within and between effect. The coefficients for the between effect of age are highly significant and very robust to the inclusion of different control variables. The size of the coefficients changed only very slightly among the columns (1) to (5). For the within effect, the regression coefficients associated with age squared and age cubed, respectively, remained unchanged in sign and significance and changed only slightly in size. Only the coefficient of the linear age term increased with the introduction of respondent and interviewer control variables from -1.0870 in column (1) to -0.7053 in column (5). Figure 3 illustrates the change of the regression coefficients associated with the age variable throughout all model specifications. Both the function of the absolute and the marginal effect of age on SWB is shifted upwards if the regression equation accounts for additional individual-level controls. This has two distinct consequences. First, with the introduction of the interviewer FE (column 5), the absolute within effect of age turns positive for individuals older than 40 years. In the previous specifications (columns 1 to 4), the absolute within age effect remains always negative, irrespective of an individual's age. Second, the upward shift of the curve of the marginal within effect of age on SWB substantially affects the estimated turning points. While the two turning points of the baseline specification (column 1) were at the ages of 35.4 and 64.2, respectively, the estimated turning points in column (5) including the interviewer FE are at ages 17.8 and 81.6, respectively. Comparing these latter findings to those of the between effect, there is a qualitatively significant difference. The two turning points of the between effects are at ages 35.2 and 88.8 (column 5). Thus, the marginal within effect of age on SWB is positive for a duration of 63.5 years, starting from age 17.8 until the age of 81.6 years. In contrast, the marginal between effect of age on SWB is positive only for 53.6 years, starting from age 35.2 until the age of 88.8 years.

To conclude, what have we learned from the regression results as a whole? Regarding the relationship between age and SWB, the regression results clearly show that the obtained findings are mainly driven by the chosen functional specification of the age variable (i.e., linear, quadratic, or cubic) and whether the identification of the age effect employs the within or between variation in the data. Furthermore, the comparison of the three tested functional forms indicates that only the cubic relation between age and SWB leads to robust and consistent results. In addition, the results show that the within estimates of age on SWB are sensitive to the inclusion of additional individual-level controls. Finally, the recently discussed control variables survey experience and interviewer characteristics indeed have a strong impact on reported SWB measures. Throughout all specifications, the regression coefficient associated with survey experience is negative and highly statistically significant at conventional significance levels. This finding suggests that longer survey experience leads to lower reported SWB measures. In addition, reported SWB measures are lower for survey respondents if the interviewer is male and/or has extensive experience surveying respondents. However, these controls have no significant impact on the coefficients associated with the age variables and the reported R^2s. In contrast, the introduction of the interviewer FE has a strong effect on the within coefficient associated with the linear age variable and the corresponding R^2s. While the coefficients of all other age variables remain almost unchanged (both for the within and between estimates), the coefficient of the linear age variable in the within dimension increases in all model specifications, as shown in column (5) of Tables 7 to 9, respectively. Moreover, the model's fit is significantly higher for the cubic functional relationship of the age variable compared to the linear and quadratic specifications.

6 Conclusion

This paper contributes to the extensive but conflicting literature on the evolution of individual life satisfaction across the life span. The empirical findings on the topic are relatively mixed. While the majority of studies report a U-shaped relationship between well-being and age, other studies have found that the association is flat, inverted U-shaped, or that it follows a wave-like pattern. A major caveat of the literature is the lack of comparability among the existing studies, as they use different data sets, econometric methods, control variables, and – based on their assumptions – functional specifications of the age variable used in the regression equations. The large between-study heterogeneity prevents any final conclusions from being drawn about the lifecycle pattern of individual life satisfaction. In essence, the heterogeneous results found on the topic could either reflect a true relationship or simply be a statistical artefact caused by differences in study design.

We use a correlated random effects (CRE) econometric framework to address the identification problem between SWB and age. Based on longitudinal data from the German Socio-Economic Panel (SOEP) during the period 1992 to 2016, we estimate a hybrid version of the CRE model to simultaneously estimate the within and between effects of age on reported SWB measures. The proposed estimation framework is designed to provide evidence as to whether the inconsistent results found in the literature regarding the relationship between well-being and age (e.g., U-shaped versus flat relationship) might be caused, among other factors, by the type of data set employed (i.e., cross-sectional versus longitudinal panel data).

We investigate the (possible nonlinear) lifecycle pattern of individual life satisfaction using higher-order polynomials of the age variable. The results show that a cubic functional specification in the age variable provides a good approximation of

the pattern of well-being over the entire life span. Furthermore, the regression coefficients associated with the age variable based on the cubic specification are rather robust to the inclusion of additional individual level controls. In contrast to the linear and quadratic specification of age, the cubic functional form leads to consistent within and between effects of age on SWB. A noteworthy result is that the often cited U-shaped association between SWB and age reported in the majority of studies is only present in the between dimension, while the within effect reveals an inverted U-shaped relationship. We take this finding as evidence that a quadratic specification is too restrictive to provide consistent within and between effects of age on well-being.

Furthermore, we test the robustness of the relationship between well-being and age to the inclusion of a large battery of additional individual level controls. We start with a basic set of sociological, demographic and economic control variables such as gender, immigration status, income, employment, educational, and marital status, and among other factors. We then test the sensitivity of the main findings to the inclusion of recently discussed interviewer factors that might affect the respondent's survey behavior such as interviewer gender and interviewer survey experience. Indeed, our results indicate that respondents interviewed by a male and/or more experienced interviewer report on average lower SWB. This finding is consistent with the idea that survey respondents might be more honest about their true level of SWB if interviewed by a male and/or more experienced interviewer. Additionally, accounting for all kind of time-invariant interviewer characteristics by including interviewer FE into the regression equation improves the model's fit significantly. Regarding the estimated regression coefficients associated with the age variables, the wave-like pattern in well-being remains qualitatively unaffected by the inclusion of individual-level controls throughout all model specifications.

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A Regression Tables

Table 7: Within and Between Effects of Age on SWB – Linear Age Function

	Dependent Variable: Self-Reported Individual Well-Being (from $Low = 0$ to $High = 10$)				
	(1)	(2)	(3)	(4)	(5)
Panel A: Within Effects of Individual-Level Controls					
Age	-0.0384	0.0838	0.0851	0.0814	0.3487***
	(0.1252)	(0.1252)	(0.1252)	(0.1253)	(0.1291)
ln Net Income	0.2936***	0.2952***	0.2955***	0.2960***	0.2990***
	(0.0103)	(0.0102)	(0.0102)	(0.0102)	(0.0102)
Employed	0.0481***	0.0563***	0.0563***	0.0562***	0.0549***
	(0.0092)	(0.0092)	(0.0092)	(0.0092)	(0.0091)
Health Status	-0.4850***	-0.4829***	-0.4829***	-0.4828***	-0.4793***
	(0.0046)	(0.0047)	(0.0047)	(0.0047)	(0.0046)
ln Survey Experience		-0.1176***	-0.1185***	-0.1042***	-0.1130***
		(0.0087)	(0.0087)	(0.0090)	(0.0097)
Interviewer Gender			-0.0255**	-0.0246**	
			(0.0116)	(0.0116)	
ln Interviewer Experience				-0.0325***	-0.0340***
				(0.0055)	(0.0120)
Panel B: Between Effects of Individual-Level Controls					
Age	0.1170***	0.1179***	0.1179***	0.1178***	0.1012***
	(0.0171)	(0.0170)	(0.0170)	(0.0170)	(0.0166)
ln Net Income	0.5137***	0.5135***	0.5138***	0.5148***	0.5168***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)	(0.0128)
Employed	0.0528***	0.0551***	0.0552***	0.0546***	0.0327**
	(0.0168)	(0.0168)	(0.0168)	(0.0168)	(0.0164)
Health Status	-0.9662***	-0.9655***	-0.9657***	-0.9657***	-0.9549***
	(0.0081)	(0.0081)	(0.0081)	(0.0081)	(0.0081)
ln Survey Experience		-0.0525***	-0.0526***	-0.0424***	-0.0262***
		(0.0085)	(0.0085)	(0.0089)	(0.0094)
Interviewer Gender			-0.0179	-0.0184*	
			(0.0111)	(0.0111)	
ln Interviewer Experience				-0.0328***	0.0049
				(0.0081)	(0.0332)
Panel C: Time-Constant Effects of Individual-Level Controls					
Male	-0.1537***	-0.1543***	-0.1542***	-0.1542***	-0.1437***
	(0.0097)	(0.0097)	(0.0097)	(0.0097)	(0.0094)
German-Born	-0.0203	-0.0088	-0.0085	-0.0092	-0.0106
	(0.0150)	(0.0151)	(0.0151)	(0.0151)	(0.0152)
Observations	382,012	382,012	382,012	382,012	382,012
Number of Individuals	49,756	49,756	49,756	49,756	49,756
R^2 Within	0.0875	0.0883	0.0884	0.0885	0.102
R^2 Overall	0.291	0.291	0.291	0.292	0.327
R^2 Between	0.404	0.404	0.404	0.404	0.459
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
State-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Educational Status	Yes	Yes	Yes	Yes	Yes
Marital Status	Yes	Yes	Yes	Yes	Yes
Number of Children	Yes	Yes	Yes	Yes	Yes
Birth Decade Fixed Effects	Yes	Yes	Yes	Yes	Yes
Panel Attrition Control	Yes	Yes	Yes	Yes	Yes
Survey-Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Interviewer ID Fixed Effects	No	No	No	No	Yes

Notes: The dependent variable is self-reported individual well-being, measured from $Low = 0$ to $High = 10$. *ln Net Income* is the log of the monthly household net income (in EUR). *Employed* refers to an indicator variable that takes the value 1 for individuals who are currently employed. *Health Status* is the current self-rated health status, measured as *very good*=1 to *bad*=5. *ln Survey Experience* is the log of the number of years a particular individual appears in the survey. *Interviewer Gender* is an indicator variable that takes the value 1 if the interviewer is male. *ln Interviewer Experience* is the log of the number of years a particular interviewer conducts interviews in the SOEP. *Male* takes the value 1 for males. *German-Born* takes the value 1 for individuals born in Germany or German immigrants prior to the year 1949. *State-Year Fixed Effects* refer to a set of Federal-State-Year Time Fixed Effects. *Education Status* refer to a set of indicator variables for individuals with an educational status lower than secondary school or with completed secondary school educatio n. *Marital Status* refer to a set of indicator variables for individuals being single, married, separated, or divorced. *No. of Children* refers to the number of children in the household. *Birth Decade Fixed Effects* refer to a set of indicator variables for each birth decade in the survey. Constant term included but not shown. *Panel Attrition Control* refers to an indicator variable which is 1 if the individual does not participate in the next wave of the survey. *Survey-Type Fixed Effects* refer to a set of indicator variables with respect to the type of survey (e.g., phone, self-filled (with/without interviewer), verbal and/or written, with/without accompanying person but with interpreter). *Interviewer ID Fixed Effects* refer to a set of indicator variables according to the unique Interviewer ID number.

Standard errors, clustered at the individual level, are shown in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 8: Within and Between Effects of Age on SWB – Quadratic Age Function

	Dependent Variable: Self-Reported Individual Well-Being (from *Low* = 0 to *High* = 10)				
	(1)	(2)	(3)	(4)	(5)
Panel A: Within Effects of Individual-Level Controls					
Age	0.1043	0.2429*	0.2451*	0.2388*	0.5033***
	(0.1277)	(0.1277)	(0.1276)	(0.1278)	(0.1318)
Age *squared*	-0.0136***	-0.0149***	-0.0150***	-0.0148***	-0.0145***
	(0.0028)	(0.0028)	(0.0027)	(0.0028)	(0.0028)
ln Net Income	0.2885***	0.2896***	0.2898***	0.2904***	0.2937***
	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0102)
Employed	0.0369***	0.0442***	0.0441***	0.0442***	0.0435***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0093)
Health Status	-0.4845***	-0.4823***	-0.4823***	-0.4822***	-0.4787***
	(0.0046)	(0.0047)	(0.0047)	(0.0047)	(0.0046)
ln Survey Experience		-0.1200***	-0.1209***	-0.1069***	-0.1162***
		(0.0087)	(0.0087)	(0.0090)	(0.0097)
Interviewer Gender			-0.0265**	-0.0257**	
			(0.0116)	(0.0116)	
ln Interviewer Experience				-0.0318***	-0.0326***
				(0.0055)	(0.0120)
Panel B: Between Effects of Individual-Level Controls					
Age	-0.2311***	-0.2350***	-0.2350***	-0.2362***	-0.2593***
	(0.0353)	(0.0353)	(0.0353)	(0.0353)	(0.0348)
Age *squared*	0.0359***	0.0364***	0.0364***	0.0365***	0.0373***
	(0.0032)	(0.0032)	(0.0032)	(0.0032)	(0.0032)
ln Net Income	0.5097***	0.5094***	0.5097***	0.5108***	0.5127***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)	(0.0127)
Employed	0.1016***	0.1047***	0.1048***	0.1043***	0.0831***
	(0.0175)	(0.0175)	(0.0175)	(0.0175)	(0.0171)
Health Status	-0.9566***	-0.9557***	-0.9559***	-0.9559***	-0.9450***
	(0.0082)	(0.0082)	(0.0082)	(0.0082)	(0.0081)
ln Survey Experience		-0.0552***	-0.0553***	-0.0448***	-0.0290***
		(0.0085)	(0.0085)	(0.0089)	(0.0094)
Interviewer Gender			-0.0179	-0.0185*	
			(0.0110)	(0.0110)	
ln Interviewer Experience				-0.0338***	0.0011
				(0.0081)	(0.0331)
Panel C: Time-Constant Effects of Individual-Level Controls					
Male	-0.1610***	-0.1618***	-0.1617***	-0.1618***	-0.1514***
	(0.0098)	(0.0098)	(0.0098)	(0.0098)	(0.0094)
German-Born	-0.0389***	-0.0271*	-0.0268*	-0.0276*	-0.0287*
	(0.0151)	(0.0152)	(0.0152)	(0.0152)	(0.0152)
Observations	382,012	382,012	382,012	382,012	382,012
Number of Individuals	49,756	49,756	49,756	49,756	49,756
R^2 Within	0.0876	0.0885	0.0886	0.0887	0.102
R^2 Overall	0.291	0.292	0.292	0.292	0.328
R^2 Between	0.406	0.406	0.406	0.406	0.461
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
State-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Educational Status	Yes	Yes	Yes	Yes	Yes
Marital Status	Yes	Yes	Yes	Yes	Yes
Number of Children	Yes	Yes	Yes	Yes	Yes
Birth Decade Fixed Effects	Yes	Yes	Yes	Yes	Yes
Panel Attrition Control	Yes	Yes	Yes	Yes	Yes
Survey-Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Interviewer ID Fixed Effects	No	No	No	No	Yes

Notes: The dependent variable is self-reported individual well-being, measured from *Low* = 0 to *High* = 10. *ln Net Income* is the log of the monthly household net income (in EUR). *Employed* refers to an indicator variable that takes the value 1 for individuals who are currently employed. *Health Status* is the current self-rated health status, measured as *very good*=1 to *bad*=5. *ln Survey Experience* is the log of the number of years a particular individual appears in the survey. *Interviewer Gender* is an indicator variable that takes the value 1 if the interviewer is male. *ln Interviewer Experience* is the log of the number of years a particular interviewer conducts interviews in the SOEP. *Male* takes the value 1 for males. *German-Born* takes the value 1 for individuals born in Germany or German immigrants prior to the year 1949. *State-Year Fixed Effects* refer to a set of Federal-State-Year Time Fixed Effects. *Education Status* refer to a set of indicator variables for individuals with educational status less than high school or completed high school education. *Marital Status* refer to a set of indicator variables for individuals being single, married, separated, or divorced. *No. of Children* refers to the number of children in the household. *Birth Decade Fixed Effects* refer to a set of indicator variables for each birth decade in the survey. Constant term included but not shown. *Panel Attrition Control* refers to an indicator variable which is 1 if the individual does not participate in the next wave of the survey. *Survey-Type Fixed Effects* refer to a set of indicator variables with respect to the type of survey (e.g., phone, self-filled (with/without interviewer), verbal and/or written, with/without accompanying person but with interpreter). *Interviewer ID Fixed Effects* refer to a set of indicator variables according to the unique Interviewer ID number. Standard errors, clustered at the individual level, are shown in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

Table 9: Within and Between Effects of Age on SWB – Cubic Age Function

	Dependent Variable: Self-Reported Individual Well-Being (from *Low* = 0 to *High* = 10)				
	(1)	(2)	(3)	(4)	(5)
Panel A: Within Effects of Individual-Level Controls					
Age	-1.0870***	-0.9309***	-0.9286***	-0.9366***	-0.7053***
	(0.1483)	(0.1482)	(0.1481)	(0.1483)	(0.1518)
Age *squared*	0.2378***	0.2320***	0.2319***	0.2325***	0.2404***
	(0.0173)	(0.0173)	(0.0173)	(0.0173)	(0.0172)
Age *cubed*	-0.0159***	-0.0156***	-0.0156***	-0.0156***	-0.0161***
	(0.0011)	(0.0011)	(0.0011)	(0.0011)	(0.0011)
ln Net Income	0.2862***	0.2873***	0.2876***	0.2882***	0.2914***
	(0.0103)	(0.0103)	(0.0103)	(0.0103)	(0.0102)
Employed	0.0652***	0.0718***	0.0717***	0.0718***	0.0716***
	(0.0094)	(0.0094)	(0.0094)	(0.0094)	(0.0093)
Health Status	-0.4822***	-0.4801***	-0.4801***	-0.4801***	-0.4765***
	(0.0046)	(0.0046)	(0.0046)	(0.0046)	(0.0046)
ln Survey Experience		-0.1165***	-0.1174***	-0.1032***	-0.1123***
		(0.0087)	(0.0087)	(0.0090)	(0.0097)
Interviewer Gender			-0.0263**	-0.0255**	
			(0.0116)	(0.0116)	
ln Interviewer Experience				-0.0322***	-0.0340***
				(0.0055)	(0.0120)
Panel B: Between Effects of Individual-Level Controls					
Age	-1.0365***	-1.0768***	-1.0766***	-1.0718***	-1.0721***
	(0.0983)	(0.0986)	(0.0986)	(0.0985)	(0.0965)
Age *squared*	0.2093***	0.2176***	0.2175***	0.2163***	0.2123***
	(0.0202)	(0.0202)	(0.0202)	(0.0202)	(0.0197)
Age *cubed*	-0.0112***	-0.0118***	-0.0117***	-0.0117***	-0.0114***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)	(0.0013)
ln Net Income	0.4997***	0.4990***	0.4993***	0.5004***	0.5026***
	(0.0126)	(0.0126)	(0.0126)	(0.0126)	(0.0128)
Employed	0.1291***	0.1338***	0.1338***	0.1332***	0.1111***
	(0.0178)	(0.0178)	(0.0178)	(0.0178)	(0.0173)
Health Status	-0.9559***	-0.9549***	-0.9551***	-0.9551***	-0.9440***
	(0.0081)	(0.0081)	(0.0082)	(0.0081)	(0.0081)
ln Survey Experience		-0.0601***	-0.0603***	-0.0501***	-0.0349***
		(0.0085)	(0.0085)	(0.0089)	(0.0094)
Interviewer Gender			-0.0178	-0.0183*	
			(0.0110)	(0.0110)	
ln Interviewer Experience				-0.0325***	0.0003
				(0.0081)	(0.0331)
Panel C: Time-Constant Effects of Individual-Level Controls					
Male	-0.1657***	-0.1667***	-0.1667***	-0.1667***	-0.1563***
	(0.0098)	(0.0098)	(0.0098)	(0.0098)	(0.0094)
German-Born	-0.0468***	-0.0343**	-0.0340**	-0.0347**	-0.0353**
	(0.0151)	(0.0152)	(0.0152)	(0.0152)	(0.0152)
Observations	382,012	382,012	382,012	382,012	382,012
Number of Individuals	49,756	49,756	49,756	49,756	49,756
R^2 Within	0.0891	0.0899	0.0899	0.0901	0.103
R^2 Overall	0.292	0.293	0.293	0.293	0.329
R^2 Between	0.407	0.407	0.407	0.407	0.462
Individual Fixed Effects	Yes	Yes	Yes	Yes	Yes
State-Year Fixed Effects	Yes	Yes	Yes	Yes	Yes
Educational Status	Yes	Yes	Yes	Yes	Yes
Marital Status	Yes	Yes	Yes	Yes	Yes
Number of Children	Yes	Yes	Yes	Yes	Yes
Birth Decade Fixed Effects	Yes	Yes	Yes	Yes	Yes
Panel Attrition Control	Yes	Yes	Yes	Yes	Yes
Survey-Type Fixed Effects	Yes	Yes	Yes	Yes	Yes
Interviewer ID Fixed Effects	No	No	No	No	Yes

Notes: The dependent variable is self-reported individual well-being, measured from *Low* = 0 to *High* = 10. *ln Net Income* is the log of the monthly household net income (in EUR). *Employed* refers to an indicator variable that takes the value 1 for individuals who are currently employed. *Health Status* is the current self-rated health status, measured as *very good*=1 to *bad*=5. *ln Survey Experience* is the log of the number of years a particular individual appears in the survey. *Interviewer Gender* is an indicator variable that takes the value 1 if the interviewer is male. *ln Interviewer Experience* is the log of the number of years a particular interviewer conducts interviews in the SOEP. *Male* takes the value 1 for males. *German-Born* takes the value 1 for individuals born in Germany or German immigrants prior to the year 1949. *State-Year Fixed Effects* refer to a set of Federal-State-Year Time Fixed Effects. *Education Status* refer to a set of indicator variables for individuals with educational status less than high school or completed high school education. *Marital Status* refer to a set of indicator variables for individuals being single, married, separated, or divorced. *No. of Children* refers to the number of children in the household. *Birth Decade Fixed Effects* refer to a set of indicator variables for each birth decade in the survey. Constant term included but not shown. *Panel Attrition Control* refers to an indicator variable which is 1 if the individual does not participate in the next wave of the survey. *Survey-Type Fixed Effects* refer to a set of indicator variables with respect to the type of survey (e.g., phone, self-filled (with/without interviewer), verbal and/or written, with/without accompanying person but with interpreter). *Interviewer ID Fixed Effects* refer to a set of indicator variables according to the unique Interviewer ID number. Standard errors, clustered at the individual level, are shown in parentheses.

*: Significant at the 10% level. **: Significant at the 5% level. ***: Significant at the 1% level.

B Descriptive Statistics

Table 10: Summary Statistics for the Main Regression Variables of the German SOEP Household Survey

Variable	N	Mean	SD	Minimum	Maximum
SWB	382012	7.0906	1.7521	0	10
Age	382012	4.8218	1.6918	1.6000	10.5000
Age squared	382012	26.1117	17.3310	2.5600	110.2500
Age cubed	382012	154.7460	147.7413	4.0960	1157.6250
ln Net Income	382012	7.7376	0.568	2.3026	12.2061
Employed	382012	0.6137	0.4869	0	1
Health Status	382012	2.6182	0.9617	1	5
ln Survey Experience	382012	1.9325	0.9326	0	3.4965
Interviewer Gender	382012	0.5683	0.4953	0	1
ln Interviewer Experience	382012	11.3838	7.5512	1	33
Male	382012	0.4728	0.4993	0	1
German-Born	382012	0.8482	0.3588	0	1
Number of Children	382012	0.6656	1.0228	0	11
Marital: Single	382012	0.2044	0.4033	0	1
Marital: Married	382012	0.6347	0.4815	0	1
Marital: Separated	382012	0.0226	0.1487	0	1
Marital: Divorced	382012	0.0741	0.2619	0	1
Marital: Widowed	382012	0.0642	0.2451	0	1
Education: Below High School	382012	0.1930	0.3947	0	1
Education: High School	382012	0.6124	0.4872	0	1
Education: Above High School	382012	0.1946	0.3959	0	1

Table 11: Pairwise Correlations for the Main Regression Variables of the German SOEP Household Survey

			Age	Age		German	Marital Status:					Number of	Health	ln Net		Educational Status relative to High School			ln Survey	Interviewer	Interviewer
Variable	SWB	Age	squared	cubed	Male	Born	Single	Married	Separated	Divorced	Widowed	children	Status	Income	Employed	Below	High School	Above	Experience	Gender	Experience
SWB	1.0000																				
Age	-0.0617	1.0000																			
Age squared	-0.0565	0.9837	1.0000																		
Age cubed	-0.0513	0.9443	0.9877	1.0000																	
Male	-0.0014	-0.0051	-0.0080	-0.0119	1.0000																
German-Born	-0.0100	0.0912	0.1015	0.1058	-0.0045	1.0000															
Marital: Single	0.0039	-0.5008	-0.4264	-0.3600	0.0530	0.0827	1.0000														
Marital: Married	0.0758	0.2095	0.1420	0.0846	0.0613	-0.1064	-0.6681	1.0000													
Marital: Separated	-0.0513	-0.0029	-0.0111	-0.0164	-0.0167	-0.0218	-0.0771	-0.2006	1.0000												
Marital: Divorced	-0.0698	0.0438	0.0196	-0.0005	-0.0608	0.0293	-0.1434	-0.3729	-0.0431	1.0000											
Marital: Widowed	-0.0497	0.3673	0.4084	0.4367	-0.1326	0.0549	-0.1327	-0.3452	-0.0399	-0.0741	1.0000										
Number of children	0.0677	-0.3745	-0.3960	-0.3916	-0.0176	-0.1445	-0.1240	0.1982	0.0105	-0.0424	-0.1465	1.0000									
Health Status	-0.4267	0.3819	0.3750	0.3595	-0.0472	0.0141	-0.1900	0.0582	0.0097	0.0378	0.1520	-0.1545	1.0000								
ln Net Income	0.2489	-0.1066	-0.1399	-0.1628	0.0709	0.0671	-0.0952	0.2873	-0.0716	-0.1494	-0.2048	0.1859	-0.1785	1.0000							
Employed	0.0799	-0.4142	-0.4754	-0.5064	0.1293	0.0150	0.0730	0.0310	0.0226	0.0450	-0.2427	0.1664	-0.2379	0.2725	1.0000						
Education: Below High School	-0.0673	-0.0209	0.0157	0.0409	-0.1068	-0.2417	0.0504	-0.0823	0.0038	-0.0174	0.0951	0.0221	0.0762	-0.2072	-0.1958	1.0000					
Education: High School	-0.0300	-0.0133	-0.0241	-0.0304	0.0369	0.1663	-0.0125	0.0134	-0.0053	0.0212	-0.0252	-0.0313	0.0104	-0.0750	0.0604	-0.6147	1.0000				
Education: Above High School	0.1040	0.0372	0.0140	-0.0034	0.0611	0.0362	-0.0349	0.0656	0.0027	-0.0087	-0.0638	0.0165	-0.0888	0.2989	0.1208	-0.2404	-0.6178	1.0000			
ln Survey Experience	-0.1154	0.1666	0.1688	0.1640	0.0156	0.0765	-0.0306	0.0042	0.0056	-0.0178	0.0576	-0.1803	0.1152	-0.0164	-0.0305	0.0373	-0.0178	-0.0153	1.0000		
Interviewer Gender	0.0028	0.0145	0.0142	0.0135	0.0047	0.0216	0.0023	-0.0038	-0.0104	0.0009	0.0091	-0.0091	-0.0067	-0.0041	-0.0110	-0.0032	0.0092	-0.0082	-0.0384	1.0000	
Interviewer Experience	-0.0276	0.0914	0.0939	0.0930	0.0051	0.0093	-0.0058	-0.0131	0.0099	0.0039	0.0251	-0.1139	0.0388	0.0722	-0.0185	0.0053	-0.0370	0.0403	0.4436	-0.0432	1.0000

C Figures

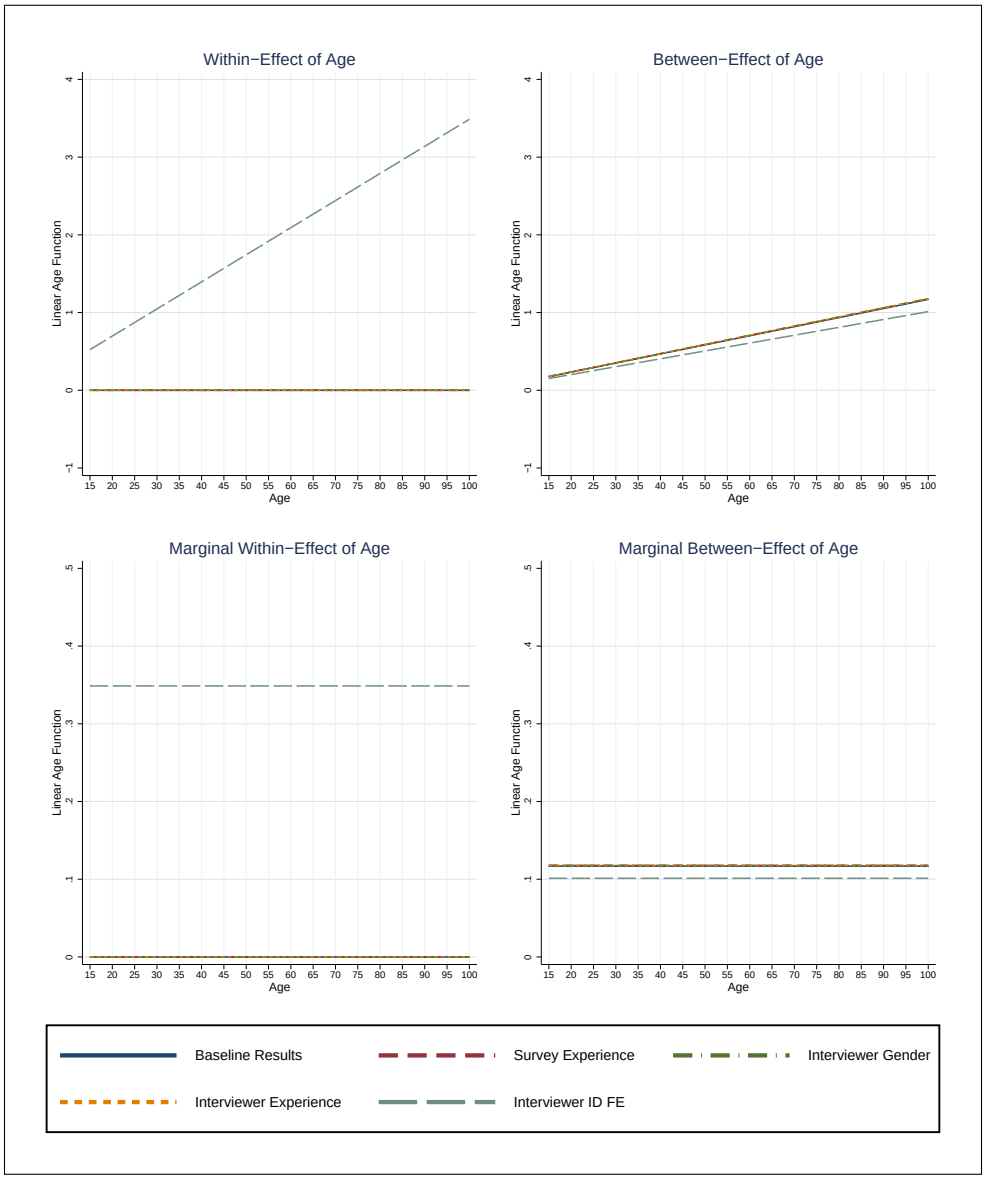

Figure 1: Relationship Between Subjective Well-Being and Age – Linear Age Function

Notes: This figure shows the *within*-effect and *between*-effect of age on subjective well-being based on the coefficient estimates in Table 7. See the main text for additional details on the estimation method and the set of included individual level controls.

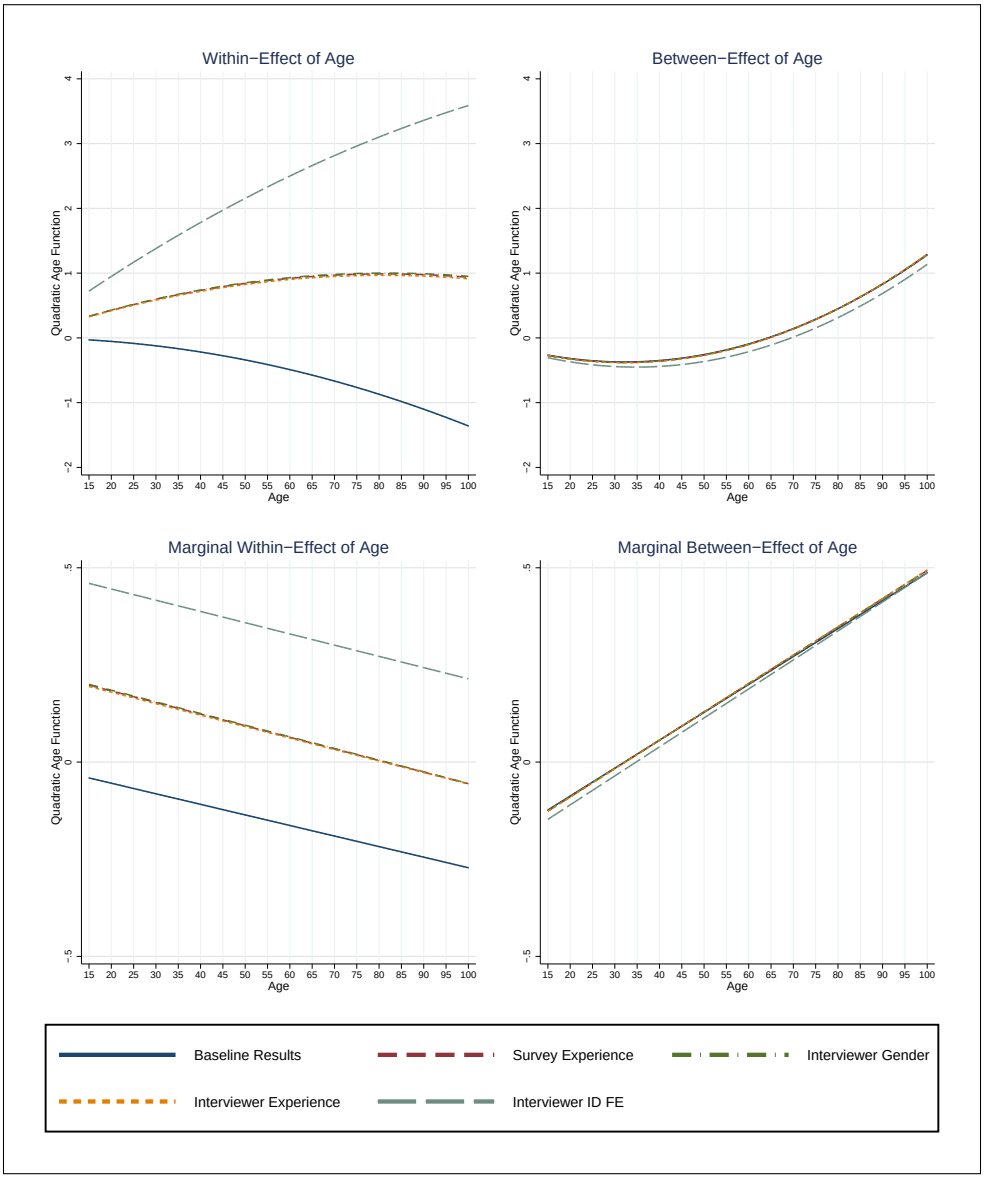

Figure 2: Relationship Between Subjective Well-Being and Age – Squared Age Function

Notes: This figure shows the *within*-effect and *between*-effect of age on subjective well-being based on the coefficient estimates in Table 8. See the main text for additional details on the estimation method and the set of included individual level controls.

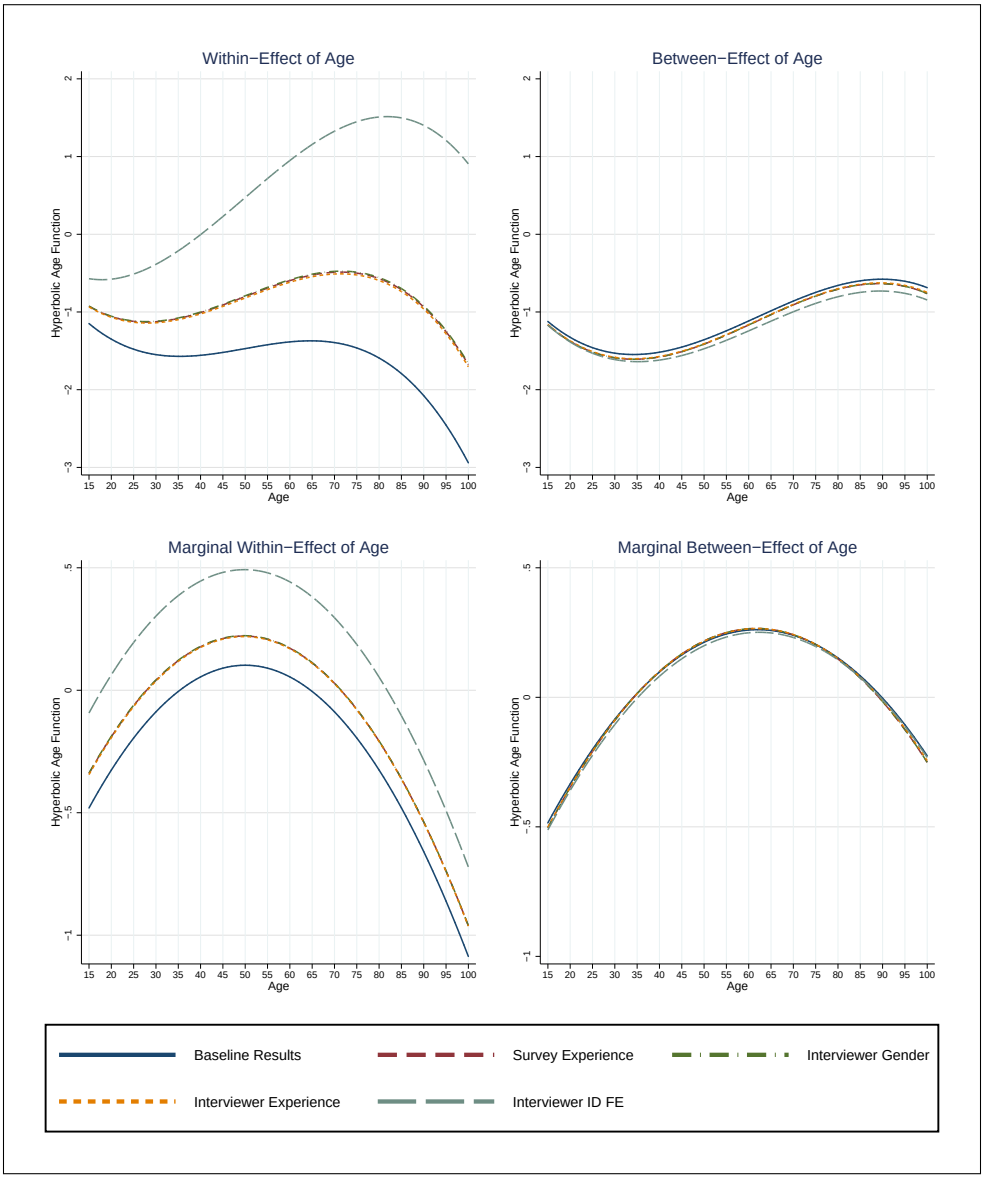

Figure 3: Relationship Between Subjective Well-Being and Age – Cubed Age Function

Notes: This figure shows the *within*-effect and *between*-effect of age on subjective well-being based on the coefficient estimates in Table 9. See the main text for additional details on the estimation method and the set of included individual level controls.

D Data Description

Table 12: Data Description for the Main Regression Variables of the German SOEP Household Survey

Variable	Description
SWB	Life satisfaction measured on an 11 point scale. Answer to the question: "*How satisfied are you at present with your life, all things considered? Please respond using the following scale, where '0' indicates not at all satisfied and '10' indicates completely satisfied*"
Age	Age of individual in (1 unit = 10 years). Generated variable in SOEP, by substraction of birth year from survey year.
Net Income	Total monthly net income of household.
Employed	Dummy variable indicating whether the respondent is employed (=1) or undemployed (=0) at the time of the interview.
Health Status	Self-reported individual health status rated on a five point Likert scale from 1 (very good) to 5 (bad).
Survey Experience	Total times the individual has taken part in the survey.
Interviewer Gender	Gender of person who interviewed the respondent.
Interviewer Experience	Total times the interviewer was part of the survey team and actually interviewed a respondent. Interviewer experience is independent from survey experience since interviewers may change across time.
Male	Dummy variable indicating whether the respondent is male (=1) or female (=0).
German-Born	Dummy variable taking a value of 1 for individuals born in Germany or if the individual immigrated to Germany prior to the year 1949, and zero otherwise.
No of Children	The total number of children living in the household at the time of the interview.
Marital: Single	Dummy variable indicating whether a person is single (=1) at the time of the interview and has not been married before.
Marital: Married	Dummy variable indicating whether a person is married (=1) at the time of the interview.
Marital: Separated	Dummy variable indicating whether a person is married and separated from his/her partner (=1) at the time of the interview.
Marital: Divorced	Dummy variable indicating whether a person is divorced (=1) at the time of the interview.
Marital: Widowed	Dummy variable indicating whether a person is married and the partner has died (=1).
Education: Below High School	Dummy variable indicating whether the highest degree of education a person has achieved is below high school level.
Education: High School	Dummy variable indicating whether the highest degree of education a person has achieved is equal to high school level.
Education: Above High School	Dummy variable indicating whether the highest degree of education a person has achieved is higher than high school level.

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